LITTER AND SOIL INHABITING MICROCOLEOPTERA OF SOUTHWEST NORTH DAKOTA[1,2]

James W. Smith[3], Christian Y. Oseto[4], and Edward U. Balsbaugh, Jr.[5]

ABSTRACT: A two year study in southwest North Dakota yielded sixteen species in thirteen families of microcoleoptera (< 2.0 mm body length) that inhabit litter and the soil surface. During the summers of 1976-77, a soil arthropod survey was undertaken in Dunn, Hettinger, McKenzie, and Slope counties as part of the Regional Environmental Assessment Program (REAP). REAP was initiated to evaluate environmental and socioeconomic impacts caused by coal development activities in the region.

In conjunction with the Regional Environmental Assessment Program (REAP) for southwest North Dakota, a study of the microcoleoptera, or minute beetles, was undertaken to determine which species inhabit the soil in the study area in question. REAP was established to provide baseline data for assessing impacts of industrial development. The term micro-coleoptera carries no nomenclatorial status as a category of beetles, but was arbitrarily used to mean any member of the order Coleoptera less than 2.0 mm. total body length. In southwest North Dakota, we found 13 families of beetles which included members less than 2.0 mm. long. The study area consisted of four counties in North Dakota, located in the southwest corner of the state. The study was undertaken during June, July, and August of 1976 and 1977.

METHODS

Diverse habitat types are represented in the four study sites in Dunn, Hettinger, McKenzie, and Slope counties. The sites can be characterized as follows:

Dunn County—a 1.6 hectare site in a stand of bur oak, *Quercus macrocarpa* Michx., situated between a pasture and an oat field. The oat field margin is largely composed of alfalfa, *Medicago sativa* L. A stock watering pond is located near the oak stand.

Hettinger County—the site is located in a shelterbelt of *Amelanchier alnifolia* Nutt. and *Caragana arborescens* Lam., situated between a cultivated wheat field and a farm-

[1]Received December 8, 1978

[2]Approved by the Director of the N.D. Agric. Exp. Sta. as Journal Series No. 954. Supported in part by North Dakota Regional Environmental Assessment Program, Project 6-02-3.

[3,4,5] Graduate Research Assistant, Assistant Professor of Entomology, and Associate Professor of Entomology respectively, North Dakota State University, Fargo, N.D. 58105

stead. *Setaria lutescens* (Weigel) Stuntz and *Agoseris cuspidata* (Pursh.) Raf. are found in the rows between the trees, and *Astragalus canadensis* L. was found as the major volunteer in the belt.

McKenzie County—a 4 hectare site located in an upland pasture to the north and a wooded ravine to the south. The major pasture grass is little bluestem, *Andropogon scoparius* Michx., and the major tree species in the ravine are quaking aspen, *Populus tremuloides* Michx., and american elm, *Ulmus americana* L. Blue grama, *Bouteloua gracilis* (HBK) Lag. is also found extensively down the slope of the pasture.

Slope County—a study area located on a hillside of mixed prairie—wooded habitat. Ponderosa pine, *Pinus ponderosa* Laws., columnar juniper, *Juniperus scopulorum* (Sargent) Rydb., and creeping juniper, *J. horizontalis* Moench, make up the major woody species; the dominant grasses were little bluestem, *Andropogon scoparius* Michx., and side-oats grama, *Bouteloua curtipendula* (Michx.) Torr. The substrate on the slopes is rocky. One extensive area of moss is present, along with a dense cover of 2.5 or more cm. of pine needles.

Soil samples were obtained with a soil sampler whose core was 8 cm. diameter and 20 cm. depth. The top layer of duff and decaying vegetation was included, along with any green plants picked up in the core. The cores were placed in plastic bags, coded with a REAP file number, and returned to the laboratory. In the laboratory, soil-inhabiting arthropods were extracted using a modified Tullgren funnel. The soil sample was placed in the funnel so that the only avenue of escape was into the collecting tube. A 60 watt incandescent bulb, in conjunction with a rheostat control, provided variable levels of heat intensity. Low heat was used initially, and heat was increased after 24 hours. After 48 hours, the collection tube was removed and beetles which met the criterion of 2.0 mm length or less were transferred to 70% ethanol for storage and further study. Each sample was assigned a REAP file number identical to the one it received in the field.

Determinations were made with a binocular dissecting microscope. Beetles were placed in a well slide (16 mm diameter by 2 mm depth) along with enough glycerine to submerge the beetle. In those instances where a beetle was curled excessively, a shallow well slide (16 mm diameter by 0.5 mm depth) and a coverslip were utilized to force the beetle into an extended posture for better viewing. The slide was illuminated by a double light source which facilitated the observation of lightly sclerotized and jointed parts, especially segments of appendages. The glycerine eliminated problems with reflection off the fluid surface, and permitted easy manipulation of the specimen. After determination to species, beetles were washed in 70% ethanol, dried, pointed using Gelva® as the mounting medium, and deposited in the North Dakota Insect Reference Collection (NDSU), Fargo, ND.

RESULTS

Sixteen species of microcoleoptera in as many genera and thirteen families were identified from the samples in southwest North Dakota. Certain of these beeltes appear to be habitat specific, while others are more generally distributed (Table 1). Some microcoleoptera were collected in such low numbers that no definite conclusions can be drawn about their habits and habitats.

Cryptophagidae: *Anchicera ovalis* Casey–This species was found associated with leaf litter in the aspen wooded ravine. The beetles are thought to feed on mold, fleshy fungus, decayed leaves, and similar materials (Arnett, 1971).

Orthoperidae: *Arthrolips decolor* LeConte–This beetle was present in large numbers in the grassland communities. It feeds on decomposing plant material and the spores of fungi (Hatch, 1957). Some orthoperids are thought to be carnivorous (Arnett, 1971). Several adult specimens of *A. decolor* were cleared in lactophenol so that the alimentary canal could be seen directly through the body wall. Gut analyses made on these REAP orthoperids were inconclusive because the alimentary canal was empty.

Orthoperus scutellaris LeConte–This beetle was present in the leaf litter soil cores in Dunn and Hettinger counties and feeds on fungal spores and decomposing plant material (Hatch, 1957).

Ptiliidae: *Ptilium columbianum* Matthews–*P. columbianum* was found in Dunn and Slope counties, in tree covered areas and in moss. It is notable for its large size [for a *Ptilium*], elongate form, pale color, and very long antennae (Matthews, 1884).

Acratrichis sp.–These were found in a stand of aspen in October of 1976 and were collected only one time.

Staphylinidae: *Habrocerus schwarzi* Horn–Blatchley (1910) said that *H. schwarzi* is boreal and may be found in northern Indiana. This record is from the leaf litter in McKenzie county, which is composed mainly of aspen. Four undetermined Aleocharinae were taken in McKenzie, Hettinger, and Slope counties in four different samples.

Lathridiidae: *Melanophthalma americana* Mannerheim–This beetle is reported to be common and has been reared from *Abies lasiocarpa* (Hook.) Nutt. (Hatch, 1962). Our specimens presented some difficulty because of variation. Some of the specimens were clearly *M. americana* while others had many characteristics of *M. cavicollis* Mann. Fall (1899) spoke of the problem: "The very limited material [of *M. americana*]. . . gave no indication of the really unusual variability to which many species of this family are known to be subject, and. . . which are now seen to be so completely connected by intermediates. . . that their subsequent recognition by students is a practical impossibility.". Using the extremes of variability present, we dissected and examined genitalia. All beetles appeared to be one species and were determined to resemble *M. americana* more than *M. cavicollis*. *M. americana* was present at all sites except McKenzie county, and apparently is not dependent on *Abies lasiocarpa* for its life cycle, but instead is adaptable and widely dispersed in southwest North Dakota.

Pselaphidae: *Pselaphus ulkei* Bowman–This beetle, with antennae-like palpi (Hatch, 1962, pl.X, fig. 7), was taken in an extensive growth of moss in Slope county, in October, 1976. This late season collection was done as a reconnaissance survey of the area for selection of the next year's collecting sites, and only a couple of the 1976 sampling sites were visited. The moss was chosen because it had previously been rich in organ-

isms, especially minute beetles. The moss was collected extensively throughout the 1977 visits, but no more *P. ulkei* were found. However, the REAP survey ended in August, and no October collection trips were possible in 1977. Hatch (1962) said that *P. ulkei* occupies areas that were recently glaciated, and so may be considered boreal.

Scaphidiidae: *Baeocera apicalis* Fall–Blatchley (1910) took *B. apicalis* by sifting damp leaves from low moist ground. The REAP survey shows *B. apicalis* to be present in the McKenzie ravine in leaf litter and in the previously mentioned moss in Slope county. Arnett (1971) said that little is known concerning the adult habits and ecology.

Leiodidae: *Agathidium politum* LeConte–Not much is published concerning these contractile beetles which can roll up into a ball, except that they frequent logs bearing fungal growth, especially beneath loose bark. These beetles were taken in a pine-juniper stand which had numerous fallen branches.

Carabidae: *Polyderis laevus* Say–This tiny carabid was taken along the north edge of the shelterbelt in Hettinger county. Blatchley (1910) claimed it is one of the smallest carabids. Our specimens are 1.2 mm. He recorded *P. laevus* from under leaves along the borders of marshes. Lindroth (1966) stated: "This species seems not to be riparian. Darlington informs me that he has found it under stones in good soil.". The REAP Hettinger site was not close to any river or creek, so that *P. laevus* is almost certainly not riparian.

Bruchidae: *Abutiloneus seminulum* Horn–This species was present along the edge of a wheat field in Dunn county. Blatchley (1910) reported *A. seminulum* from dogwood flowers. Horn (1873) described this species from sweeps, with the comment: "[*A. seminulum*] occurs over a wide extent of country, specimens being known from Pennsylvania, Nebraska, Dacota (sic), and California.".

Chrysomelidae: *Longitarsus testaceus* Melsheimer–One specimen was taken in the McKenzie wooded ravine on October 8, 1976. Balsbaugh and Hays (1972) collected large series of *L. testaceus* on *Cirsium* spp., which was probably *C. undulatum* (Nutt.) Spreng., or bull thistle. Bull thistle is common in the REAP collecting sites. Blatchley (1910) noted that *L. testaceus* hibernates beneath logs and mullein leaves. Although it was not observed at the McKenzie site, mullein is present in southwest North Dakota, and the date of collection would lead one to believe that *L. testaceus* was hibernating. *L. testaceus* is a resident of northwest South Dakota, viz. in Buffalo, Spearfish, Sturgis, and Wall (Kirk and Balsbaugh, 1975).

One specimen each of two other beetle families, **Scydmaenidae** and **Colydiidae**, were taken in the shelterbelt in Hettinger county. Unfortunately, they were irreparably damaged and not determined further. No other representatives of either family were taken in the REAP collections.

DISCUSSION

Many beetles that would qualify as microcoleoptera are better collected by methods not employed in this study: treehole duff sifting, windowpane trap, aerial stickyboards or traps, beating brush piles, and blacklight trapping. However, the entomology section of REAP was designed primarily to monitor soil arthropods, and so only those minute beetles living in or on the soil were collected. Future surveys for microcoleoptera which employ the above collecting methods or others not mentioned will probably yield a much greater diversity of micro-coleoptera for southwest North Dakota.

Table 1. Summary of litter and soil inhabiting microcoleoptera collected in southwest North Dakota by year, month, location, and type of habitat.

BEETLE	YEAR	MONTH	COUNTY-SITE
Carabidae			
Polyderis laevus Say	77	Jy,A	H7
Staphylinidae			
Habrocerus schwarzi Horn	76	A	M4
undetermined Aleocharinae	77	J,Jy,A	M4,H5,H7,H9
Pselaphidae			
Pselaphus ulkei Bowman	76	0	S10
Leiodidae			
Agathidium politum LeConte	77	Jy	S9
Ptiliidae			
Ptilium columbianum Matthews	76,77	J,Jy,A	D3,S9,S10
Acratrichis spp.	76	0	M4
Scydmaenidae			
undetermined sp.	76	Jy	H5
Scaphidiidae			
Baeocera apicalis LeConte	76,77	J,O	M4,S10
Cryptophagidae			
Anchicera ovalis Casey	76	Jy,A	D2,M4
Orthoperidae			
Arthrolips decolor LeConte	76,77	Jy,A,S	D1,D2,S8
Orthoperus scutellaris	76,77	Jy,S	D3,H7
Lathridiidae			
Melanophthalma americana Mann.	76,77	Jy,A,O	D1,D2,H5,H7,S9,S10
Colydiidae			
undetermined sp.	76	Jy	H6
Chrysomelidae			
Longitarsus testaceus Melsheimer	76	O	M4
Bruchidae			
Abutiloneus seminulum Horn	77	Jy	D1

J=June; Jy=July; A=August; S=September; O=October; D1=Dunn-oats; D2=Dunn-grassland; D3=Dunn-oak woodland; M4=McKenzie-aspen woodland; H5=Hettinger-shelterbelt; H6=Hettinger-E. edge belt; H7=Hettinger-N. edge belt; S8=Slope-grassland; S9=Slope-pine-juniper woodland; S10=Slope-moss.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. Robert B. Carlson, Department of Entomology, NDSU, for critically reviewing and advising on this manuscript. We also wish to thank Dr. Burruss McDaniel, South Dakota State University, for the loan of voucher specimens for verification of species names, and Dr. Allan C. Ashworth, Geology Department, NDSU, Dr. Terry L. Erwin,National Museum of Natural History, and Dr. Ian Moore, Division of Biological Control, University of California, Riverside, for their help in making determinations.

REFERENCES

Arnett, R.H., Jr. 1963. An Introduction to the Study of Beetles. Catholic University of America Press, Washington, D.C. 40 pp.

_____. 1971. The Beetles of the United States, 3rd printing. American Entomological Institute, Ann Arbor, Michigan. 1112 pp.

Balsbaugh, E.U., Jr. and K.L. Hays. 1972. The Leaf Beetles of Alabama (Coleoptera: Chrysomelidae). Auburn University Agr. Exp. Sta. Bull. 441. 223 pp.

Blatchley, W.S. 1910. Coleoptera or Beetles Known to Occur in Indiana. Nature Publishing Co., Indianapolis, Indiana. 1386 pp.

Fall, H.C. 1899. Revision of the Lathridiidae of Boreal America. Trans. Amer. Entomol. Soc. 26:101-190.

Hatch, M.H. 1975. The Beetles of the Pacific Northwest; Part II: Staphyliniformia. University of Washington Press, Seattle. 384 pp.

_____. 1962. The Beetles of the Pacific Northwest; Part III: Pselaphidae and Diversicornia I. University of Washington Press, Seattle. 503 pp.

Horn, G.H. 1873. Descriptions of new species of U.S. Coleoptera. Trans. Amer. Entomol. Soc. 4: 311-342.

Kirk, V.M. and E.U. Balsbaugh,Jr. 1975. A list of the Beetles of South Dakota. South Dakota State University Agr. Exp. Sta. Tech. Bull. 42. 139 pp.

Lindroth, C.H. 1966. The Ground-Beetles (Carabidae excl. Cicindelinae) of Canada and Alaska. Opusc. Entomol. Supp. 33: 409-648.

Matthews, Rev. A. 1884. Synonymy of North American Trichopterygidae. Trans. Amer. Entomol. Soc. 11: 113-156.